Chapter 6

Cumulative Impacts

This page intentionally left blank.

6.1 Introduction

This chapter addresses the cumulative impacts of the reservoir operations policy alternatives and other reasonably foreseeable actions, in compliance with regulations implementing NEPA. Cumulative impacts are defined as the effects of the proposed action when considered together with other past, present, and reasonably foreseeable future actions.

As noted in Chapter 1, the ROS EIS is a Programmatic EIS. Its broad geographic scope (the entire Tennessee River watershed) includes most of TVA's water control system, and the ROS evaluates a system-wide reservoir operations policy. Consistent with the programmatic approach of the EIS and broad scale of the ROS, the Cumulative Impact analysis addressed two types of cumulative impacts, future trends and future projects.

- **Future Trends**—The planning time frame of the ROS EIS is the period from 2003 to 2030. Over this three-decade period, existing conditions in many resource areas are expected to change; the amount and rate of change would vary by resource. For each resource, potential impacts were assessed for the conditions expected to occur in 2030 (to the extent that existing conditions were known). The cumulative change in existing conditions between the present and 2030 was assessed as part of the resource-specific analyses in Chapter 5, Environmental Consequences of the Alternatives. This chapter summarizes the cumulative aspect of future trends for each resource addressed in the EIS.

- **Future Projects**—Specific projects that are expected to be constructed and come into operation during the planning time period were also identified and evaluated. Although impacts from these projects may not be significant when considered separately, they may result in regional-scale impacts when considered together with resource-related impacts.

In addition to future trends for resources and future projects, regulatory programs— especially those that affect environmental quality—may play a role in the assessment and occurrence of cumulative impacts. State regulatory programs, such as implementation of the CAA that regulates air emissions, are designed to improve environmental conditions from their existing conditions. State water quality programs are another example. It is not possible to predict or examine the detailed effects of these regulatory programs over the 30-year study period. However, their regional or state-wide application is generally expected to affect a positive change in the environment. Such positive environmental changes were not directly accounted for in TVA's cumulative impact analysis; consequently, the analysis was generally conservative and any projected adverse cumulative impacts are likely to have been overstated.

A large number of individual state and local programs and plans have been developed by agencies within the ROS study area. Although TVA was not able to review these individual plans, based on the orientation and typically limited applicability of state and local authorities to federal multi-purpose projects, TVA assumed that implementation of any of the policy alternatives would be generally consistent with state and local plans and laws. Because most

local planning ordinances primarily establish restrictions for development and growth in areas, local ordinances would generally not be applicable to the reservoir operations policy alternatives or other ROS actions.

6.2 Cumulative Impacts Associated with Future Trends

In each resource area, relevant future trends were identified and evaluated. The following sections provide a summary of these trends and their related impacts. The evaluation of Dam Safety, Invasive Plants and Animals, Aquatic Plants, Groundwater Resources, and Water Supply concluded that no (or minimal) impacts would result under any policy alternative and, in some cases, some benefits would result for these resources. Because no impacts on these resources were identified, a cumulative impact analysis was not relevant and thus was not prepared. Similarly, the analyses for Power and Navigation were based primarily on economic changes in these sectors. The results were integrated into the economics analysis, which showed minimal changes from implementation of any of the alternatives. No cumulative impacts therefore would be associated with Power or Navigation.

6.2.1 Air Resources/Climate

TVA evaluated potential impacts on air resources and climate based on changes in air emissions and air quality. Air quality is currently good in the TVA region as measured by the NAAQS, except for higher levels of ozone in some adjacent areas. Regional haze and its impact on visibility in Class I areas (National Parks, for example) is also of concern. Air emissions in the region are likely to decrease in the future due to emissions reductions by TVA. Increased automobile travel and other new emissions sources may offset some of these decreases. TVA has installed emissions control equipment and applied other emission reduction measures to its fossil-fired power plants and has increased its nuclear and hydropower generation capacity to obtain more generation from non-emitting technologies.

On a regional basis, the Southern Appalachian Mountain Initiative (SAMI) has recommended an eight-state strategy designed to improve current air quality and mitigate the effects of future expected increases in cumulative air emissions from utility and other regional air emission sources. Chief among these strategies is the installation of emissions control equipment on existing and new emission sources, including energy generation facilities.

Increasingly stringent national emissions standards and voluntary participation in air quality improvement strategies may protect and improve current air quality. Long-term cumulative degradation in air quality is not expected to occur, and improvements in regional haze are expected.

Implementation of the Summer Hydropower Alternative, Commercial Navigation Alternative, and the Tailwater Habitat Alternative are expected to improve air quality and regional visibility. These alternatives would reduce the potential for cumulative air quality effects. Reservoir Recreation Alternative B, the Equalized Summer/Winter Flood Risk Alternative, and the Tailwater Recreation Alternative would increase air emissions. Most alternatives would result in

a seasonal shift in emissions, resulting in increased emissions in the summer period (when the atmosphere is chemically active). Overall, net annual increases in emissions would be small and would not significantly increase the potential for cumulative impacts.

All policy alternatives, except Reservoir Recreation Alternative A, the Commercial Navigation Alternative, and the Tailwater Habitat Alternative would increase HAPs, but increases are expected to be small and do not represent a cumulative air quality effect when considered with expected changes in regional HAP emissions.

Changes in CO_2 emissions were also evaluated under two alternatives, Reservoir Recreation Alternative A and the Commercial Navigation Alternative. Under these alternatives, CO_2 emissions would be reduced. All other alternatives would cause a potential increase in CO_2 emissions but at very low levels (less than 1 percent of current TVA emissions). To the extent that a relationship exists between CO_2 emissions and climate change, increases in greenhouse gas emissions caused by implementation of any policy alternative would be so small that they are unlikely to represent a cumulative impact.

6.2.2 Water Quality

Changes in water quality would directly affect the beneficial use of water in the Valley. Dissolved oxygen and temperature are critical to maintaining aquatic organisms, including threatened and endangered species. Dissolved oxygen concentrations, the formation of toxic compounds, and the growth of algae are important to water supply; water temperature is important to the operation of power plants. The use of water to assimilate oxygen-consuming wastes and the potential for low reservoir DO near the sediments may allow release of toxic compounds from sediments. Future changes to water quality are influenced by land use and development in the basin. Future basin-wide development and urbanization would increase demand for water supply, municipal wastewater disposal, and stormwater runoff. Projection of future demands on water resources is highly variable and may or may not lead to cumulative impacts on the quality of water resources. Federal and state regulatory programs, such as establishment of TMDLs, would maintain certain levels of water quality and minimize cumulative impacts.

None of the policy alternatives propose development of new physical facilities with water requirements or discharges. Changes in the reservoir operations policy are expected to cause changes in water temperature, DO, and other water quality parameters that affect the assimilative capacity and mobilization of metals and other compounds. These changes may also affect aquatic resources, as discussed in Section 6.2.3.

Implementation of any policy alternative would result in variable effects on DO, water temperature, and other water quality parameters throughout the water control system. The integration of these effects determines overall assimilative capacity (ability to accept wastewater releases) and anoxia (deprivation of oxygen). Implementation of any of the policy alternatives would not change or would benefit assimilative capacity, except the Summer Hydropower Alternative, which would adversely affect assimilative capacity in some tributary reservoirs.

Conversely, implementation of any policy alternative except the Commercial Navigation Alternative and the Summer Hydropower Alternative would result in potentially adverse impacts related to anoxia. To the extent practicable, these project impacts may be mitigated using the approaches described in Chapter 7, avoiding or reducing their potential for long-term cumulative effects.

6.2.3 Aquatic Resources

The analysis of aquatic resources found that changes in water quality variables, including DO, temperature, and water flow, would affect biodiversity in reservoir and tailwater aquatic communities. TVA has instituted programs to improve biodiversity through selected improvements in water quality. The long-term effect of these changes is anticipated to be variable, with improvements in biodiversity in some communities. Other aquatic communities are expected to generally continue in their present condition or, in some situations, may experience decline. Because aquatic communities that are included in this resource (as differentiated from threatened and endangered species) are reasonably abundant, long-term cumulative impacts are not expected to occur. Implementation of policy alternatives such as Reservoir Recreation Alternative A, Reservoir Recreation Alternative B, the Equalized Summer/Winter Flood Risk Alternative, and the Commercial Navigation Alternative would result in minimum adverse effects and thus would have little potential for an additional cumulative impact. The Summer Hydropower Alternative, Tailwater Recreation Alternative, and Tailwater Habitat Alternative may result in adverse impacts on aquatic resources and thus have the potential for cumulative impacts. These potential impacts may be mitigated using the approaches described in Chapter 7, avoiding or reducing their potential for long-term cumulative effects.

6.2.4 Wetlands

Wetlands are extensive in the TVA reservoir system and are experiencing a minor but continuous decline. This decline is cumulative, as wetland succession is not maintaining present wetland diversity and function. Through the SMI and its permitting authority, TVA manages impacts on shoreline development, and federal regulation (CWA) requires mitigation for disturbance of jurisdictional wetlands. To some extent, both of these programs mitigate the potential for long-term cumulative impacts. Implementation of Reservoir Recreation Alternative A, Reservoir Recreation Alternative B, the Tailwater Recreation Alternative, and the Tailwater Habitat Alternative would likely benefit wetlands, especially wetland type and function. The Summer Hydropower Alternative and the Equalized Summer/Winter Flood Risk Alternative could adversely affect wetlands; the Commercial Navigation Alternative is expected to result in no change. To the extent practicable, potential impacts on wetlands may be mitigated using the approaches described in Chapter 7, avoiding or reducing their potential for long-term cumulative effects. However, the effectiveness of the mitigation measures may be limited, and long-term cumulative effects could continue.

6.2.5 Terrestrial Ecology

TVA evaluated lowland and upland plant and wildlife communities in areas proximate to TVA reservoirs and tailwaters. The analysis found that these communities have adapted to the current operations of the water control system. Long-term changes in these communities are expected as a result of natural succession and changes in wetlands. These impacts would be slow and may be offsetting; therefore, broad cumulative effects would not occur. Cumulative effects are possible, at least in the short term, on shorebirds and migratory waterfowl and the plant communities of flats habitats, in addition to the potential loss of control of gravity-maintained dewatering units on wildlife refuges on affected reservoirs. Impacts would be of greatest concern if they occur during critical migratory periods. Cumulative effects may result from adverse impacts on both managed areas and wetland habitats—both important habitats for these bird populations. Conversely, all alternatives except the Summer Hydropower Alternative are expected to benefit upland wildlife. To the extent practicable, project impacts on flats and other wetland habitats important to shorebirds and migratory waterfowl may be mitigated as described in Section 7.4; therefore, the likelihood of cumulative impact would be reduced.

6.2.6 Vector Control

The annual cycle of mosquito populations is a long-term persistent issue throughout the Tennessee Valley. The mosquito is a pest species with disease-transmission potential, and management to minimize mosquito populations is ongoing throughout the region. Management programs and natural variation in the availability of breeding habitat are expected to control mosquito populations at present levels, and cumulative impacts are unlikely. Implementation of any policy alternative, except the Summer Hydropower Alternative or the Commercial Navigation Alternative, is expected to increase the availability of mosquito breeding habitat, allowing some potential increase in mosquito populations. These increases would be small and are not expected to be cumulative.

6.2.7 Threatened and Endangered Species

A number of federally listed threatened and endangered species inhabit areas in and adjacent to the reservoirs and stream reaches of the water control system. Most of these species are found in aquatic habitats, including tailwaters, flowing mainstem reaches, some modified stream reaches, and some tributary tailwaters. As indicated by their classification as threatened and endangered, many of these species are in a state of long-term decline and require protection. Plans to protect their habitat and encourage recovery have been implemented for some species and are being developed for others. Cumulative impacts on such species are usually related to further degradation of habitat from development and disturbance. Because construction of new facilities and additional land disturbance are not proposed under any policy alternative, direct or incremental cumulative impacts on terrestrial habitat would not occur. Changes to reservoir operations under policy alternatives may alter reservoir levels, water flows, and some water quality parameters—especially temperature and DO. These changes may have the potential to cause some adverse impacts on federally listed threatened and endangered species; however, the level of impact would be small and not significant enough to jeopardize the continued

existence of these species. In addition, federal actions requiring review under NEPA (such as this programmatic EIS) would also require review under the ESA, which would limit future impacts on federally listed threatened and endangered species.

6.2.8 Managed Areas and Ecologically Significant Sites

Managed Areas and Ecologically Significant Sites are designated to protect and manage sensitive resources that are typically linked with wetlands, bottomland hardwood forests, and other important habitats. Under their designation as protected areas, they are managed to preserve the resource value for which they were designated. TVA's evaluation of these areas did not identify long-term, cumulative degradation of these managed resources. However, specific resources managed at an individual site, or group of sites, may experience improvement or decline in the future. Implementation of any policy alternative, except for the Summer Hydropower Alternative and the Equalized Summer/Winter Flood Risk Alternative, would result in slightly adverse to slightly beneficial impacts on managed areas and thus would not cause long-term cumulative impacts. Implementation of either the Summer Hydropower Alternative or the Equalized Summer/Winter Flood Risk Alternative would likely cause some adverse impacts. These potential impacts may be mitigated using the approaches described in Chapter 7, avoiding or reducing their potential for long-term cumulative effects.

6.2.9 Shoreline Development and Land Use

Because none of the policy alternatives includes construction of any facilities or changes to land use, no direct cumulative impacts from implementation of the policy alternatives on land use are expected to occur. The primary trend identified in land use is continued development of residential and limited commercial uses along TVA reservoir shorelines. The SMI instituted land development controls designed to limit total shoreline residential development on all TVA reservoirs to 38 percent of lakeshore lands. The SMI forecasts that 38 percent development will be reached within the ROS planning period. Changes in the reservoir operations policy are not expected to change the cumulative extent of lakeshore residential and other development. The only impact of policy alternatives on land use may be the rate at which development would occur. Because buildout to 38 percent has been assumed in the land use analysis, no additional cumulative impact would occur.

6.2.10 Shoreline Erosion

TVA's evaluation of shoreline erosion found that ongoing natural erosion processes (rain, wind, and water flows), recreational activities, reservoir levels, and shoreline land development would continue erosion of reservoir and tailwater shorelines. TVA management programs may reduce these rates in some areas, while increased recreational activities and land development may increase erosion in other areas. The contribution of land development to overall cumulative impacts would be limited, as the maximum extent of shoreline development would be reached within the 2030 timeframe and further development would be prohibited or limited (see discussion above). The continuing effects of shoreline erosion may include further loss of shoreline habitat, changes to water quality, and impacts on cultural resources and visual

integrity. Together, these impacts may be considered cumulative. Implementation of the Summer Hydropower Alternative, Equalized Summer/Winter Flood Risk Alternative, and Commercial Navigation Alternative would result in minimal impacts and are unlikely to contribute to cumulative erosion impacts. Reservoir Recreation Alternative A, Reservoir Recreation Alternative B, the Tailwater Recreation Alternative, and the Tailwater Habitat Alternative would result in potential adverse impacts that, together with erosion of backlands and land development may contribute to potential cumulative erosion impacts. Shoreline erosion resulting from changes in the operations policy is expected to be a minor contribution to total land erosion. These potential impacts may be mitigated using the approaches described in Chapter 7, avoiding or reducing their potential for long-term cumulative effects.

6.2.11 Prime Farmland

The long-term conversion of farmland within counties in the Tennessee Valley is declining in some counties and increasing in others. Regional net loss of farmland has occurred at a modest rate and was considered a long-term cumulative impact independent of TVA's reservoir operations. However the region has a strong farm economy and it is likely that future rates of land conversion would continue to be low. Implementation of three policy alternatives (Summer Hydropower, Equalized Summer/Winter Flood Risk, and Commercial Navigation) would result in no change or a slight benefit to the preservation of farmland. The other policy alternatives may cause a small loss in farmland. Overall, changes to farmland acreage are expected to be small and are not expected to accelerate existing cumulative impacts.

6.2.12 Cultural Resources

TVA's evaluation of cultural resources found that ongoing shoreline land development and erosion are expected to continue long-term potentially cumulative impacts to the integrity of cultural resources on shoreline and near-shore reservoir bottom areas. Implementation of Reservoir Recreation Alternative A may cause additional adverse impacts, which may increase the potential that these impacts are cumulative. These potential impacts may be mitigated using the approaches described in Chapter 7, avoiding or reducing their potential for long-term cumulative effects.

6.2.13 Flood Control

Requirements for storage of flood waters in TVA reservoirs to minimize flood damage during flood events was determined from evaluation of potential flood flows, based on a 99-year historical record and additional consideration of very large storm events. Implementation of any of the policy alternatives is expected to increase flood risk, particularly when very-low probability, large storm events are considered. Significant land development has the potential to change the volume and rate of runoff from rainfall. Localized areas of rapid development could result in changes to local runoff characteristics. Changes in basin-wide land use anticipated through 2030 are not expected to result in changes in watershed runoff characteristics that would be substantial enough to interact with TVA flood control operations in a manner that

would change the outcome of future flood events. Therefore, no cumulative impacts related to flood risk are expected.

6.2.14 Visual Resources

Continued development along TVA reservoirs and tailwaters generally affects scenic quality. Development standards and controls minimize such impacts, but continued development of shorelands would result in impacts that are considered unavoidable and cumulative. Scenic quality is also affected by shoreline erosion and the exposure of reservoir bottoms during periods of lower reservoir pool levels. These effects would vary in the long term with annual variation in hydrology and operation of the water control system. All of the policy alternatives were found to benefit scenic quality related to erosion and bottom exposure except the Summer Hydropower Alternative and the Equalized Summer/Winter Risk Alternative. The adverse impacts of these policy alternatives would be potentially cumulative, depending on their extent. To the extent practicable, these project impacts may be mitigated as described in Section 7.4, thus reducing their potential to become cumulative.

6.2.15 Recreation

Recreation and use of recreation resources in general are expected to increase in the future, in relation to regional population growth. Beyond general population growth, changes in the level of recreational activity are most heavily influenced by air temperature, reservoir elevations, and tailwater flows. In dry years, when water levels are low, recreational use is depressed. In higher water years with higher temperatures, recreational use increases. Because of the variation in weather patterns and hydrologic conditions from year to year, long-term incremental change in recreational use—in addition to population growth, is difficult to discern. All of the policy alternatives except the Summer Hydropower Alternative and the Equalized Summer/Winter Flood Risk Alternative showed increased recreation primarily as a result of higher reservoir levels or increased/more stable tailwater flows. The Summer Hydropower Alternative and the Equalized Summer/Winter Flood Risk Alternative are expected to reduce recreation use due to reduced summer and fall reservoir levels and tailwater flows. While Implementation of these alternatives may lead to some level of adverse impacts on recreation, they were considered project impacts and not cumulative.

6.3 Cumulative Impacts of Future Projects

The future trends discussion represents the accumulated change of small projects and environmental resource trends. At the regional level, significant projects are also expected to occur.

6.3.1 Identification of Future Projects

A three-step process was undertaken to identify regional-scale future projects to be included in the cumulative impact analysis of future projects. This process included:

- **Listing of Possible Future Projects**—Projects of regional scale typically require environmental review at the state or federal level, or both. Candidate projects for consideration were identified by reviewing published notices related to the preparation of environmental documents. The USEPA federal government clearinghouse for NEPA compliance and state agency dockets for the period from 1995 to 2002 were searched for: Notices of Intent to Prepare an Environmental Review, Notices of Availability of Draft and Final Environmental Documents, Findings of No Significant Impact, and Notices of No Practical Alternative to Impacting Wetlands or Floodplains. These lists were searched to identify potential industrial, resource development, land development, or regulatory programs with potential cumulative effects in the Tennessee River watershed. This search identified 161 listings, which were reviewed and evaluated for their relevance. From this review, 31 candidate projects were selected based on their location, size, and status.

- **Review of Candidate Cumulative Projects**—Abstracts for candidate projects were reviewed and evaluated to determine whether a project met criteria for potential regional impact. Projects were considered that had been previously approved and not yet implemented (but which could still reasonably be implemented) or constructed, and projects that had issued a notice to proceed with environmental review (e.g., had started the environmental review process). Projects in construction or that had completed construction but not yet begun operation were also considered. Projects being discussed but for which no action had yet been taken were considered speculative and were not considered.

- **Selection of Projects for Cumulative Analysis**—Based on the scope, status, and potential cumulative effect of those projects reviewed, TVA selected the following projects for evaluation:

  - TVA Land Management Plans
  - Other land development programs
  - TVA Hydro Modernization Program

TVA also reviewed the status of forest plans for national forests proximate to the Tennessee Valley. These include the Chattahoochee-Oconee, Cherokee, and Nantahala/Pisgah National Forests and the Land Between the Lakes National Recreation Area. Forest plans had been developed and adopted in the mid-1980s for each of the national forests. Revisions to each plan were scheduled, but proposed plan revisions and the accompanying Draft EISs had not been released; therefore, these plans could not be considered in the cumulative analysis.

During the selection process, several thermal power plant projects were identified, including the addition of peaking facilities at Johnsonville, Gallatin, and Haywood Power Plants; the Kemper Combustion Turbine Plant (DeKalb, Mississipppi); and installation of Nox reduction equipment at the Kingston Fossil Plant. All of these facilities have recently been completed or will be completed before 2005 and were included in the analysis as part of the Base Case.

The specific projects identified for cumulative impact analysis are listed in Table 6.3-01. This table also summarizes the types of impacts that may be associated with each project.

Table 6.3-01 Summary of Projects Included in the Cumulative Analysis

No	Project	Description of Location	Resources Affected
1	Guntersville Reservoir Land Management Plan	Land Management Plan for 40,236 acres on Guntersville Reservoir. The plan includes 5,079 acres for project operations, 32,584 acres for resource management and conservation, 327 acres for industrial access or commercial use, 1,704 acres for recreational uses (such as campgrounds and parks) and 543 acres for residential lake access.	Assume that land development acreage is included in SMI assumptions Recreation – increased facilities
2	Tellico Reservoir Land Management Plan	Land Management Plan for 12,643 acres of TVA land on Tellico Reservoir. The plan designates 635 acres for project operations, 9,320 acres for resource management and conservation, 332 acres for industrial access or commercial use, 1,804 acres for recreational uses (campgrounds, parks, and public access areas), and 552 acres for residential lake access. Also includes designation of greenway and river corridor areas for resource protection.	Assume that land development acreage is included in SMI assumptions Ecological Resources – protection of species/habitat in areas designated for resource management Recreation – increased recreation access and facilities Visual – protection of sensitive visual resources
3	Tims Ford Reservoir Land Management Plan	Land Management Plan for 6,453 acres of state and federal lands on Tims Ford Reservoir. The plan designates 386 acres for project operations, 4,573 acres for resource management and conservation, 67 acres for industrial/commercial development, 573 acres for recreational uses (campgrounds, parks, and public access areas), and 864 acres allocated to residential access.	Assume that land development acreage is included in SMI assumptions Ecological Resources – protection of species/habitat in areas designated for resource management
4	Boone Reservoir Land Management Plan	Land Management Plan for 880 acres of TVA land on Boone Reservoir. The plan designates 209 acres for project operations, 594 acres for resource management and conservation, 76 acres for recreational uses (campgrounds, parks, and public access areas), and 1 acre allocated to residential access.	Assume that land development acreage is included in SMI assumptions Protection of sensitive resources Conservation while continuing to allow and encourage public use

Table 6.3-01 Summary of Projects Included in the Cumulative Analysis (continued)

No	Project	Description of Location	Resources Affected
5	Melton Hill Reservoir Land Management Plan	Land Management Plan for 2,578 acres of TVA land on Melton Hill Reservoir. The plan designates 294 acres for project operations, 1,890 acres for resource management and conservation, 22 acres for industrial/commercial development, 221 acres for recreational uses (campgrounds, parks, and public access areas), and 151 acres for residential lake access.	Assume that land development acreage is included in SMI assumptions Protection of sensitive resources Conservation while continuing to allow and encourage public use
6	Bear Creek Reservoirs Land Management Plan (Upper Bear Creek, Bear, Little Bear Creek, and Cedar Creek Reservoirs)	Land Management Plan for 9,178 acres of TVA land on the four Bear Creek Reservoirs. The plan designates 851 acres for project operations, 7,456 acres for resource management and conservation, 14 acres for industrial/commercial development, 616 acres for recreational uses (campgrounds, parks, and public access areas), and 241 acres for residential lake access.	Assume that land development acreage is included in SMI assumptions.Plan resulted in improved natural resources protection and management benefiting the gray bat and the bald eagle
7	Norris Reservoir Land Management Plan	Land Management Plan for 27,927 acres of TVA land on Norris Reservoir. The plan designates 934 acres for project operations, 23,776 acres for resource management and conservation, 1,744 acres for recreational uses (campgrounds, parks, and public access areas), and 1,473 acres for residential lake access.	Assume that land development acreage is included in SMI assumptions Conservation and protection of existing resources through active management on heavily used areas
8	Cherokee Reservoir Land Management Plan	Land Management Plan for 8,026 acres of TVA land on Cherokee Reservoir. The plan designates 542 acres for project operations, 6,615 acres for resource management and conservation, 601 acres for recreational uses (campgrounds, parks, and public access areas), and 268 acres for residential lake access	Assume that land development acreage is included in SMI assumptions Resource conservation and a commitment to expand and designate one new TVA Natural Area Protection of natural and cultural resources and increases in recreational use opportunities has some indirect positive impacts on socioeconomic interest

Table 6.3-01 Summary of Projects Included in the Cumulative Analysis (continued)

No	Project	Description of Location	Resources Affected
9	Pickwick Reservoir Land Management Plan	Land Management Plan for 19,238 acres of TVA land on Pickwick Reservoir. The plan designates 2,861 acres for project operations, 13,431 acres for resource management and conservation, 534 acres for industrial/commercial development, 1,327 acres for recreational uses (campgrounds, parks, and public access areas), and 1,085 acres for residential lake access	Assume that land development acreage is included in SMI assumptions Allocated a substantial amount of acreage to natural resource and sensitive resource management Identification of one natural area Identification of one area to be compatible with industrial projects
10	Chickamauga Reservoir Land Management Plan	Land Management Plan for 12,862 acres of TVA land on Chickamauga Reservoir. The plan designates 337 acres for project operations, 8,653 acres for resource management and conservation, 46 acres for industrial/commercial development, 899 acres for recreational uses (campgrounds, parks, and public access areas), and 2,927 acres for residential lake access	Assume that land development acreage is included in SMI assumptions Protection of sensitive resources Conservation while continuing to allow and encourage public use
11	Watts Bar Reservoir Land Management Plan	Land Management Plan for 11,121 acres of TVA land on Watts Bar Reservoir. The plan designates 586 acres for project operations, 7,394 acres for resource management and conservation, 142 acres for industrial/commercial development, 644 acres for recreational uses (campgrounds, parks, and public access areas), and 2,355 acres for residential lake access	Assume that land development acreage is included in SMI assumptions Protection of sensitive resources Conservation while continuing to allow and encourage public use
12	Kentucky Reservoir Land Management Plan	The Kentucky Reservoir Land Management Plan designated 66,651 acres for multiple uses. This reservoir has not been allocated into specific zones.	Assume that land development acreage is included in SMI assumptions Protection of sensitive resources Conservation while continuing to allow and encourage public use

Table 6.3-01 Summary of Projects Included in the Cumulative Analysis (continued)

No	Project	Description of Location	Resources Affected
13	Wheeler Reservoir Land Management Plan	Wheeler Reservoir Land Management Plan designated 28,004 acres for multiple uses. This reservoir has not been allocated into specific zones	Assume that land development acreage is included in SMI assumptions Protection of sensitive resources Conservation while continuing to allow and encourage public use
14	Use of Columbia Dam Project Lands	On the Duck River, upstream of the former Columbia Dam site, approximately 13,000 acres of TVA land was transferred to the State of Tennessee for management. Up to 2,000 acres are available for residential development; 3,800 acres for a possible water supply reservoir; remaining acreage was set aside for resource protection, wildlife management, and recreation.	Ecology Resources—direct impacts on resources from development of 2,000 acres but protection of natural resources on remaining 7,200 acres and possibly 3,800 more acres if water supply reservoir not developed
15	TVA Hydro Modernization Program	Hydro modernization efforts were initiated in 1992 to consider upgrading and increasing generating capacity at 92 hydropower units in the TVA power system. Projects that have been completed or are in planning design or construction were included as part of the existing system and were evaluated under the Base Case. Projects not yet in the planning phase were considered under Cumulative Impacts. Modification projects would address several types of upgrades. Upgrades would include increased efficiency and electrical output, modifications to improve management of low DO, and improved fish passage.	Power—increased generation capacity in the region Water Quality—management of low DO levels in hydro unit discharge Ecology—benefits to downstream habitat from changes in water quality

6.3.2 Cumulative Impacts Associated with TVA Land Management Plans

TVA has developed and implemented LMPs for the areas surrounding a number of its reservoirs. To the extent these plans have been adopted and implemented by TVA, they were considered part of the existing environment and were included in the Base Case.

As part of the review of future projects, LMPs for 13 TVA reservoirs were identified (see Table 6.3-01). These plans generally include management of areas ranging from 66,651 acres at Kentucky Reservoir and 40,236 acres at Guntersville Reservoir to 880 acres on Boone Reservoir and 2,578 acres on Melton Hill Reservoir. The LMPs are multi-use plans designating areas for conservation management and areas for residential and commercial/industrial access development. In all of the LMPs, except those for Kentucky and Wheeler Reservoirs, approximately 75 percent of the managed area has been preserved for resource management and conservation. Allocations for specific uses have not yet been made in the Kentucky and Wheeler Reservoir plans. To the extent that the planned development occurs along lakeshores, it was included in the SMI assessment of maximum buildout along lakeshores (see Section 4.15, Shoreline Development and Land Use).

Future implementation of each LMP would result in the development of additional residential, commercial, and recreation facilities. These plans typically preserve a large portion of the managed area for natural conservation use, including protection of habitat. While implementation of the LMPs may result in a net decrease in habitat through loss to development, the portion lost to development would be small. On a regional basis, implementation of the LMPs may provide a cumulative benefit through future protection of wildlife habitat and other resources. Implementation of the LMPs would also cause some loss of habitat but would provide a cumulative increase in the availability of regional recreational facilities.

Because none of the policy alternatives proposes development or preservation of any land areas, direct cumulative impacts of policy alternatives in concert with implementation of TVA LMPs is not expected to occur. To the extent that both implementation of policy alternatives and any of the LMPs would indirectly affect an environmental resource, cumulative effects may occur. The loss of ecological habitat from development under an LMP and increased impacts on wildlife resources from implementation of a policy alternative may result in a cumulative effect on wildlife species. Because most changes to environmental resources were found to be within the range of natural variability related to annual rainfall, runoff, and other factors that would not be affected by implementation of specific policy alternatives, cumulative impacts are unlikely to occur

6.3.3 Cumulative Impacts Associated with Land Development Programs

Continuing development and urbanization throughout the Tennessee Valley would occur over the planning period. In aggregate, this development may result in regional impacts, such as reduction in habitat, changes in surface water runoff, increased water use, and increased wastewater for disposal. None of the policy alternatives proposes the development of any new

facilities; therefore, no direct impacts associated with development and urbanization would occur that could be considered cumulative. In addition, new development that may be expected to occur adjacent to TVA reservoirs has been included as part of the Base Case and was considered in the impact analysis for relevant resources.

The review of future projects identified one large land development program that is located upstream of TVA 's former Columbia Dam site. This 12,800-acre site was transferred to the State of Tennessee for management. Under the state's plan, approximately 2,000 acres is planned for residential development. The remaining area would be primarily set aside for wildlife management. While implementation of this development plan would remove as much as 2,000 acres of natural habitat, it would preserve present natural areas. As discussed in Section 6.3.3, no cumulative impacts are expected to occur from implementation of any policy alternative in concert with this land development program.

6.3.4 Cumulative Impacts Associated with the Hydro Modernization Program

TVA is in the process of modernizing its hydropower facilities throughout the water control system. As discussed in Section 3.3.1, 40 hydro units in the system have been upgraded and an additional 21 units are in the process of being upgraded. For the purpose of this environmental impact analysis, these units were assumed to be part of the existing system and were included in the Base Case. Additional units will be considered for modernization. These units are listed in Table 6.3-02 and include projects that are in the preliminary planning phase (shown as Phase 1 in the table) or have not yet started but are scheduled to be completed by 2013. The purpose of the HMOD Program is to increase the effective output and operational flexibility of these units; nevertheless, in some circumstances, an increase in discharge flow rate would occur during operations (as noted in Table 6.3-02).

The direct impact of modernized units would be increased flows. This may cause changes in river hydrology at run-of-river projects during operation of upstream hydropower units. These projects would include the reaches below Wheeler, Ocoee #3, Watauga, Blue Ridge, and Wilbur Reservoirs. The increased flows are not expected to be outside the range of flows that would otherwise occur at these projects; therefore, the direct impacts related to flows would not cumulatively be greater than impacts already assessed in each relevant resource area under the Base Case.

Increased flows for modernized hydropower units discharging to mainstem and tributary storage reservoirs could affect water quality (principally by changes in temperature in the receiving waters). The incremental increase in discharge volume from modernized units would be small when compared to overall discharge volume and would be within the normal range of variation for release volumes such that water quality is unlikely to be changed and no cumulative impact is likely to result.

Table 6.3-02 Hydro Modernization Projects Considered in Cumulative Impact Analysis

Power Plant	Status	Receiving Water	Planned Changes	Flow Increase
Cherokee (Units 1-4)	Phase 1	Mainstem storage	High efficiency, low flow	Yes
Wheeler (Units 1–8)	Phase 1	Mainstem run-of-river	High efficiency, low flow	Not expected
Wilson (Units 19–21)	Phase 1	Mainstem storage	Increased efficiency/capacity	Expected
Fort Loudoun (Units 1–2)	Not started	Mainstem storage	Increased efficiency/capacity	Mix
Wilson (Units 1–4)	Not started	Mainstem storage	High efficiency	Yes
Wilson (Units 5–8)	Not started	Mainstem storage	High efficiency	Yes
Ocoee #3	Not started	Tributary run-of-river	Increased efficiency/capacity	Yes
Nickajack (Units 3–4)	Not started	Mainstem storage	Increased efficiency/capacity	Yes
South Holston (Unit 1)	Not started	Tributary storage	Increased efficiency/capacity	No
Melton Hill (Units 1–2)	Not started	Mainstem storage	Increased efficiency/capacity	No
Watauga (Units 1–2)	Not started	Tributary run-of-river	Increased efficiency/capacity	Yes
Blue Ridge (Unit 1)	Not started	Tributary run-of-river	Increased efficiency/capacity	Yes
Wilbur (Units 1–4)	Not started	Tributary run-of-river	Increased efficiency/capacity	Insignificant

Increased power generation capacity would allow production of additional electrical energy with the same amount of water. The TVA reservoir system currently has approximately 3,842 MW of hydropower capacity (not including Raccoon Mountain). Although this capacity would be increased through the modernization program; actual hydrologic conditions and operations of the water control system in any given year would determine the cumulative increase in electrical production. Because TVA hydropower units are often operated during periods of peak demand, increased electrical output from hydropower production could reduce the requirements for energy from fossil-fired peaking units on the TVA power system. The cumulative effects of this offset could be to displace some peak fossil production. Displacing peak fossil production with incremental hydropower production could reduce air emissions from power production. The incremental offset of fossil generation is likely to be small, however, and would occur only if no long-term increase in overall peak energy growth occurs. It is unlikely that a cumulative reduction in air emissions from incremental hydropower production as a result of modernization would occur.

This page intentionally left blank.